1. PUBLIC HEALTH STATEMENT

This public health statement tells you about hexachlorobenzene and the effects of exposure. The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Hexachlorobenzene has been found in at least 107 of the 1,613 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which hexachlorobenzene is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to hexachlorobenzene, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS HEXACHLOROBENZENE?

Hexachlorobenzene is a white crystalline solid. This compound does not occur naturally. It is formed as a by-product during the manufacture of chemicals used as solvents (substances used to dissolve other substances), other chlorine-containing compounds, and pesticides. Small amounts of hexachlorobenzene can also be produced during combustion processes such as burning of city wastes. It may also be produced as a by-product in waste streams of chlor-alkali and wood-preserving plants. Hexachlorobenzene was widely used as a pesticide until 1965. It was also used to make fireworks, ammunition, and synthetic rubber. Currently, the substance is not used

commercially in the United States. For more information on the physical and chemical properties of this substance, see Chapter 4.

1.2 WHAT HAPPENS TO HEXACHLOROBENZENE WHEN IT ENTERS THE ENVIRONMENT?

Hexachlorobenzene tends to remain in the environment for a long time. If it is released to the soil, it has a half-life of 3–6 years. This means that half of the total amount will disappear after 3–6 years, half of the remaining amount will disappear in another 3–6 years, and this process will continue each 3–6 years thereafter. If it is released to surface waters such as lakes, rivers, and streams, the half-life is 2.7–5.7 years, and if it is released to groundwater, the half-life is 5.3–11.4 years. Since hexachlorobenzene does not dissolve in water very well, most of it will remain in particles on the bottom of lakes, rivers, or streams. The evaporation of hexachlorobenzene into the air is not significant under ordinary conditions. Once in the air, it can be carried over wide geographic areas. Its half-life in air ranges from 0.63 to 6.28 years. For more information on the releases, occurrence, and movement of this substance, see Chapters 4, 5, and 6.

1.3 HOW MIGHT I BE EXPOSED TO HEXACHLOROBENZENE?

You may be exposed to hexachlorobenzene if you live near an industrial site where it is produced as an unintentional by-product or as a minor part of another chemical product. You may also be exposed if you live near a hazardous waste site where hexachlorobenzene has been discarded. At these sites, hexachlorobenzene may be carried in the air on dust particles. The levels of it in the air around these sites are not known. The amount you might breathe in urban air is very small, about 0.00003 parts per million (ppm). If you work in an industry that uses or produces it unintentionally as a by-product, you may also breathe in hexachlorobenzene particles or dust that carries it, and it may touch your skin. In workplaces where hexachlorobenzene is used or disposed, an estimated 1–1.4 ppm of this substance has been measured in the air. You can also be exposed to it through contact with soil or dust particles contaminated with hexachlorobenzene, or by breathing air contaminated by industrial releases into the environment.

Because it does not dissolve easily in water, this substance is usually not present in high concentrations in drinking water. Based on a national survey, it was detected at very low levels in surface water and groundwater systems. Drinking water in three cities contained only trace amounts of hexachlorobenzene. Therefore, exposure to this substance through drinking water is limited.

Eating foods such as shellfish, fish, and certain vegetables can also expose people to hexachlorobenzene. Additionally, you can be exposed to hexachlorobenzene by eating and drinking foods and liquids, such as milk, other dairy products, meat, and poultry, if the animals from which these products are obtained have been exposed to it through their feed or other sources of contamination. Additionally, fat and oil in food may increase the amount of hexachlorobenzene that enters the body from food.

Low levels of hexachlorobenzene have been found in the fatty tissues of almost all people tested. These amounts are most likely the result of low levels in food. An estimated average yearly uptake of 1 microgram per kilogram (μg/kg) of body weight has been calculated for exposure to contaminated food. Exposure by breathing contaminated air is estimated to be 0.01 μg/kg/year. This is 100 times less than the exposure from eating contaminated foods. Drinking contaminated water is estimated to contribute only very small amounts (0.00085 μg/kg/year). For more information, see Chapter 6.

1.4 HOW CAN HEXACHLOROBENZENE ENTER AND LEAVE MY BODY?

Hexachlorobenzene can enter your body when you eat food contaminated with it, when you breathe particles of it in the air, or when it gets on your skin. After it enters your body, it rapidly spreads through your blood to many tissues in the body, especially to fat. This probably happens within a few hours. Based on the results of a survey of this substance in people's tissues, it will remain in your body, especially in fat, for years. A large portion of hexachlorobenzene in the fat of a mother can be transferred to her baby in breast milk. During pregnancy, this substance can transfer to the unborn child through the mother's blood. Most of it leaves your body in the feces; smaller amounts are found in urine. For more information, see Chapter 3.

1.5 HOW CAN HEXACHLOROBENZENE AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

A study of people in Turkey who, over a period of several years, ate grain that was accidentally contaminated with hexachlorobenzene, showed a high death rate in young children of mothers who ate it and in young children who ate it themselves. Nursing infants may be in particular danger from the transfer of hexachlorobenzene through breast milk if their mothers have been exposed. Unborn children may also be at particular risk because of the transfer of hexachlorobenzene through the mother's blood during pregnancy. This has been confirmed by experiments in animals.

People in Turkey who, over a long time, ate grain that was accidentally contaminated with hexachlorobenzene suffered from a liver disease called porphyria cutanea tarda. The main effect of porphyria is slowed or stopped formation of heme, the oxygen-carrying part of the hemoglobin molecule found in red blood cells and an important chemical in the body. Porphyria is identified by elevation of heme precursors called porphyrins in the blood, urine, and stool. This disease can cause red-colored urine, skin sores, change in skin color, arthritis, and problems of the liver, nervous system, and stomach. Studies in animals also show that eating hexachlorobenzene for a long time can harm mostly the liver, thyroid, and nervous systems; the studies in animals also show that eating hexachlorobenzene for months or years can damage bones,

kidneys, and blood, and the immune, endocrine (hormone-releasing), and nervous systems. Unborn children and young children may be more sensitive to these effects than adults.

Studies in animals also suggest that eating this substance for months or years can cause cancer of the liver, kidney, and thyroid, but there is no strong evidence that the substance causes cancer in people. The U.S. Department of Health and Human Services (DHHS) has determined that the substance may reasonably be anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) has determined that hexachlorobenzene is possibly carcinogenic to humans. EPA has determined that hexachlorobenzene is a probable human carcinogen. See Chapter 3 for more information.

There is no information on levels of hexachlorobenzene in air that affect people. No information is available on the taste or lowest levels at which you can taste or smell it in air or water. Therefore, people may not know when hexachlorobenzene is present in air or water. Studies conducted with rats indicate that breathing hexachlorobenzene may harm the immune system. The health effects from getting it on your skin are not known.

For more information on the levels of this substance that have caused health effects in people and animals, see Chapters 2 and 3.

1.6 HOW CAN HEXACHLOROBENZENE AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Infants and young children appeared to be especially sensitive to the effects of hexachloro-benzene in the Turkish grain poisoning epidemic. Breast-fed infants of mothers known to have ingested the contaminated bread developed a disease known as pembe yara or "pink sore." The disease was named for the skin lesions that were produced. Other symptoms were weakness and convulsions. Many of the sickened infants died from this disease. Young children beyond

2 years of age did not get pink sore, but they did develop numerous skin, nervous system, and bone abnormalities later in life.

One study found higher levels of hexachlorobenzene in mother's milk in babies who had ear infections than in the milk of babies without ear infections. Another study found higher levels of hexachlorobenzene in the fat of boys with a specific type of birth defect, undescended testis, than in the fat of normal boys. We do not know if hexachlorobenzene caused the infection or the birth defect.

Animal studies support the suggestion that young animals exposed to hexachlorobenzene before and soon after birth are especially sensitive to hexachlorobenzene. Effects on the liver, nervous system, and immune function occurred at lower doses in the young developing animals than in adults. Animal studies also showed that hexachlorobenzene has effects on various endocrine organs, including the thyroid gland (hypothyroidism), parathyroid gland (hyperparathyroidism), adrenal gland, and ovaries. These tissues produce hormones that are important to normal growth and development of the organism.

You can find more information about how hexachlorobenzene can affect children in Sections 3.7 and 6.6.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO HEXACHLOROBENZENE?

If your doctor finds that you have been exposed to significant amounts of hexachlorobenzene, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

The primary way most people are exposed is through food. Fatty food may be higher in hexachlorobenzene than less fatty food. Additionally, when hexachlorobenzene is present in food, more may be absorbed when the food is fatty than when the food is less fatty. Therefore, eating less fatty food may reduce the risk of exposure to hexachlorobenzene.

If you live near an industrial site where hexachlorobenzene was produced or is produced as an unintentional by-product or you live near a hazardous waste site where it has been discarded, there may be high levels of hexachlorobenzene in the water and soil. Substituting cleaner sources of water and limiting contact with soil (for example, through use of a dense ground cover or thick lawn) would reduce family exposure to hexachlorobenzene. Produce grown in contaminated soil should not be eaten. By paying careful attention to dust and dirt control in the home (air filters, frequent cleaning), you can reduce family exposure to contaminated dirt. Some children eat a lot of dirt. You should prevent your children from eating dirt. You should discourage your children from putting objects in their mouths. Make sure that they wash their hands frequently and before eating. Discourage your children from putting their hands in their mouths or from other hand-to-mouth activity.

It is sometimes possible to carry hexachlorobenzene from work on your clothing, skin, hair, tools, or other objects removed from the workplace. This is particularly likely if you work in the chemical or pesticide industries. You may contaminate your car, home, or other locations outside work where children might be exposed to hexachlorobenzene. You should know about this possibility if you work where hexachlorobenzene exposure may occur.

Your occupational health and safety officer at work can and should tell you whether chemicals you work with are dangerous and likely to be carried home on your clothes, body, or tools and whether you should be showering and changing clothes before you leave work, storing your street clothes in a separate area of the workplace, or laundering your work clothes at home separately from other clothes. Material safety data sheets (MSDS) for many chemicals used should be found at your place of work, as required by the Occupational Safety and Health Administration (OSHA) in the U.S. Department of Labor. MSDS information should include chemical names and hazardous ingredients, and important properties, such as fire and explosion data, potential health effects, how you get the chemical(s) in your body, how to properly handle the materials, and what to do in the case of emergencies. Your employer is legally responsible for providing a safe workplace and should freely answer your questions about hazardous chemicals. Your state OSHA-approved occupational safety and health program or OSHA itself can answer any further questions and help your employer identify and correct problems with hazardous substances. Your state OSHA-approved occupational safety and health program or OSHA will listen to your formal complaints about workplace health hazards and inspect your workplace when necessary. Employees have a right to seek safety and health on the job without fear of punishment.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO HEXACHLOROBENZENE?

Blood, breast milk, urine, and feces may be tested to determine if you have ever been exposed to hexachlorobenzene. These tests are not usually available at a doctor's office because they require special equipment found at county, state, university, and independent analytical laboratories. Because this compound can collect and remain in human fat for several years, the test for this substance in breast milk can tell you only that you have been exposed, but not when or to how much. The blood, urine, and feces tests can indicate more recent exposure. However, the levels measured cannot be used to predict what health effects might occur in people. Blood, urine, and feces can also be monitored for porphyrins. High porphyrin levels indicate slowed formation of heme, which is a major effect of hexachlorobenzene in the body. The usefulness of

this test as a sign of hexachlorobenzene exposure is limited, however, because there are many other potential causes of high porphyrin levels. For more information, see Chapters 3 and 7.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for hexachlorobenzene include the following:

EPA has developed advisories to protect people from the potential health effects of exposure to hexachlorobenzene in drinking water. EPA has proposed that drinking water should not contain more than 0.05 parts of hexachlorobenzene per million parts of water (ppm) in water that children drink, and should not exceed 0.2 ppm in water that adults drink for longer periods (approximately 7 years). No other health standards or recommendations exist for this substance.

You can find more information on regulations and guidelines that apply to hexachlorobenzene in Chapter 8.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Web site: http://www.atsdr.cdc.gov

* Information line and technical assistance

Phone: 1-888-42-ATSDR (1-888-422-8737)
Fax: 1-404-498-0057

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

* To order toxicological profiles, contact

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 605-6000